IMPROVED, PROGRESSIVELY COLLAPSIBLE DISPOSABLE CONTAINER

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The present invention relates to an improved, progressively-collapsible disposable container. In particular, the invention relates to a container of this type in which improvements to the way of collapsing have been introduced, so as to make collapsing easier and more even, as well as to the stability of the container when it finds itself in a partly or fully collapsed configuration.

Variable-volume containers, and in particular bottles, are known in the art, formed by a circular-section or polygonal-section cylindrical container, the walls of which consist of a bellows-structure which is in an extended configuration when the bottle is full. As the bottle content is used up, the inner volume of the container may be changed, through progressive folding of the bellows structure (operation simply referred to as "bottle collapsing" in the following), to adjust to the content reduction and keep the air volume at the top of the container to a minimum.

Since of course during collapsing the container outer volume decreases accordingly too, the above-described collapsible container also has the advantage of allowing the taking up of space, in the location where it is stored, which is always proportional to its contents. Finally, when the contents are completely used up and folding of the bellows structure is complete, the container has reached its minimum volume and can hence be directly discarded in the recyclable waste, i.e. without any further compactation operation, as is instead normally required for traditional empty containers, in order to reduce their bulk.

Containers of this type are particularly suitable for storing perishable goods, such as for example food products, and drinks in particular. Keeping a low volume of air above such products, in fact, allows to reduce the oxidation speed of the same and hence to maintain their organoleptic properties longer.

In EP 1 150 889 in the name of the same Applicants, a container of this type is disclosed which, unlike previously-

known containers, is characterised by a very stable collapsed configuration. The container itself is hence not subject to any returning-back-to-its-original-shape phenomena, even when it is subject to forces acting in such sense, as occurs for example while pouring the liquid contents of a bottle or keeping a bottle containing fizzy liquid closed.

Once filed the above-mentioned patent, the inventors of the present application have continued their studies and experiments for the purpose of obtaining further improvements of the container of their invention, with the main purpose of making the container collapsing more even and effective and making its collapsed configuration even more stable.

The present invention has been defined on the basis of the results of such studies and experiments and relates to a disposable, progressively-collapsible container, of the type in which at least part of the lateral surface of the container consists of a bellows structure comprising a plurality of adjacent folds, each fold being formed by two opposite surfaces of different width, characterised in that the larger-width surface has a greater stiffness than the smaller-width surface.

According to an important feature of the invention, the stiffness increase is obtained by changing the shape of the larger surface, which is shaped so as to form a stiffening rib projecting outwards of the container.

Other features and advantages of the present invention will in any case be more evident from the following description of a preferred embodiment of the invention, illustrated in the accompanying drawings, wherein:

fig. 1 is a front view of a bottle according to the present invention with a downturned bellows, in an unfolded configuration;

fig. 2 is a front view of the bottle of fig. 1, in a collapsed configuration;

fig. 3 is a front view of a bottle according to the present invention with an upturned bellows, in an unfolded configuration;

fig. 4 is a front view of the bottle of fig. 3, in a

collapsed configuration;

fig. 5 is a highly enlarged section view of the side wall of the bottles of figs. 1 to 2 (or, upside down, of figs. 3 and 4), in an unfolded configuration; and

fig. 6 is a highly enlarged section view of the side wall of the bottles of figs. 1 to 2 (or, upside down, of figs. 3 and 4), in a collapsed configuration.

According to the main feature of the present invention, in order to obtain an even collapsing of the bottle, the larger surface of each fold of the bellows side wall of the container - that is the one against and into which the smaller surface folds up during collapsing - is stiffer than said smaller surface. This solution positively departs from the prior art, where indeed the two surfaces forming each fold of the bellows are generally continuously flat or moderately arched and hence the larger surface is less stiff than the smaller one, the stiffness of said surfaces obviously being inversely proportional to their width.

Thanks to this feature of the larger surfaces of all the bellows folds, i.e. that of being stiffer than the corresponding smaller surfaces, said larger surfaces of the bellows maintain their shape substantially unchanged during collapsing and can thereby transfer in an even manner, to the smaller surfaces interposed therebetween, the squashing force imparted by the consumer onto the neck area or onto the bottle cap. Said smaller surfaces with a lower stiffness are thereby subjected to forces acting in opposite directions, in correspondence of their inner and outer edges, respectively, evenly distributed over the entire bottle circumference, so that collapsing of said surfaces occurs in a perfectly even and homogeneous manner, avoiding phenomena of localised deflections or of bottle ovalisations which may easily occur when the two surfaces of the bellows are of an inverted stiffness level in respect of those defined in the present invention, as indeed happens in the prior art.

In figs. 1 to 4 is illustrated a bottle manufactured according to the teachings of the present invention. The bottle 1 comprises bellows side walls 2, a top portion 3 with a neck 4

onto which a cap is screwed on, and a bottom portion 5. The bellows side walls 2 are at least partly formed by a certain number of bellows elements 6 - which in the present description will be simply referred to as "folds" - each formed by two opposing surfaces, and precisely by a larger surface 7 and by a smaller surface 8.

In the bottle illustrated in fig. 1, the folds 6 have the larger surface 7 on top and the smaller one 8 on the bottom, so that the bottle collapsing (fig. 2) occurs "downwards". This arrangement of the side wall of the bottle 1 has been referred to as "downturned bellows". On the contrary, the bottle illustrated in fig. 3 is upturned, so that collapsing of the folds (fig. 4) occurs "upwards ". This arrangement of the bottle side wall has been referred to as "upturned bellows". The two arrangements are of course entirely equivalent, so that in the following detailed description no distinction will be made between the two cases.

The highest stiffness level of the larger surface of each fold of the bellows is obtained, in a preferred embodiment of the present invention, as a shape stiffness. This means that the two surfaces 7 and 8 forming each bellows are made of the same material and are substantially of the same thickness, the greater stiffness of the surface 7 being obtained thanks to the fact that such surface is formed with a stiffening rib projecting outwards from the bottle.

A preferred embodiment of the larger surface 7 of each bellows is illustrated in fig. 5 which shows, in a highly enlarged scale and in cross-section, a portion of the side wall 2 of the collapsible bottle 1 according to the present invention. In this drawing the structure of the individual folds 6 can be seen in greater detail, each formed by a larger surface 7 and by a smaller surface 8. The larger surface 7, instead of having the plane or arched pattern known from the prior art (shown by the partly discontinued line AD), comprises a large step-rib 9 projecting outwards from the bottle so that, in cross-section, the surface 7 is represented by a rounded-corner broken line ABCD comprising a step-portion ABC followed by a

plane portion CD aligned to the directrix AD.

The maximum height h of the step-rib 9 in respect of the directrix AD, measured in correspondence of the elbow bend B of said rib, is preferably comprised between 20 and 50% of the overall dimensions of the surface 7, that is of the length of segment AD. The extension of said step-area 9, measured along the directrix AD, is then preferably comprised between 60 and 80% of the length BE.

The smaller surface 8 of the fold 6 has a planar arrangement or, preferably, the arched arrangement claimed in EP-1.150.889 and shown in fig. 5 (portion DE), with the convexity of the curvature facing towards the larger surface 7 against which it collapses. The surfaces 7 and 8 are connected to each other through a rounded-off edge at location D, which represents the hinging point of the bellows 6 during bottle collapsing.

According to an additional feature of the present invention, the folds 6 are mutually separated, in correspondence of the bottom of the folds themselves, by anular sections 10 having a shell-shaped profile. As well as the function, known per se, of giving a greater crosswise stiffness to the bottle, the anular sections 10 have such a shape as to aid collapsing of the bottle 1 and to make the bottle even more stable in its collapsed configuration.

The anular stiffening sections of the known type in fact simply consist of a vertical, sub-vertical or arched wall, directly connected to the surfaces of the two adjacent folds. On the contrary, according to the present invention, each anular section, as is well-visible in a cross-section in fig. 5, comprises a vertical, sub-vertical or arched wall FG which is connected to the surfaces of the adjacent folds, ED and AB, through horizontal or sub-horizontal walls EF and AG. Moreover, the orientation and/or the curvature of such connecting walls is such as to form, with the corresponding surfaces of the adjacent folds, angular areas DÊF and BÂG having a curvature opposite to the one taken up by the same areas when the bottle is in a collapsed configuration.

During collapse, the angular areas DÊF and BÂG hence move - by snapping, thanks to the high instability of the intermediate position - from the initial equilibrium position, illustrated in fig. 5, to a very stable final equilibrium position illustrated in fig. 6. Snapping from one to the other of the two equilibrium configurations, in addition to aiding collapse, positively contributes to give a particularly high level of stability to the collapsed bottle configuration.

Upon changing from the initial to the collapsed configuration, the lateral surfaces 7 and 8 of the folds 6 - or, more precisely, the circular angular areas DÊF and BÂG - are subject to a temporary deformation, heightening their curvature to a greater degree over the initial and final condition of said areas. This is due to the fact that the radial width of the folds 6, i.e. the geometrical distance between the crests and the bottoms thereof, remains substantially unchanged during bottle collapsing, and hence the width of the above-mentioned circular angular areas DÊF and BÂG must correspondingly diminish as the folds are collapsed.

The deformation of the lateral surfaces 7 and 8 may determine circumferential dissymmetries, i.e. such deformation may vary according to the different locations along the circumference where it occurs, and this may in turn determine an uneven collapsing of the folds 6, with formation of ovalisations or vertical deflection. According to another feature of the present invention, this problem may be avoided providing, in correspondence of the connecting areas between the lateral surfaces of the folds 6, and in particular in correspondence of the crests D of said folds, a plurality of micro-incisions circumferentially arranged in a symmetrical manner. For example, said microincisions may be in the shape of 8 semi-spherical micro-depressions, symmetrically provided every 45° along the bottle circumference. The function of these micro-incisions is to create unhomogeneity points in the stress distribution during collapse, so that the deformation of the folds lateral surfaces is in a sort of wavy pattern, having the same symmetrical arrangement as the above-mentioned micro-incisions. The bottle

collapsing is consequently much more even and formation of ovalised areas or of vertical deflection is prevented.

The present invention has been described with reference to a preferred embodiment thereof, but it is evident that the scope of protection of the invention is not limited to such embodiment, but also comprises all the possible variants within the reach of a person skilled in the art, provided they are comprised in the definitions detailed in the accompanying claims.